PHYSICS

NCERT - NCERT PHYSICS(GUJRATI)

SEMICONDUCTOR ELECTRONICS: MATERIALS, DEVICES AND SIMPLE CIRCUITS

Examples

1. C, Si and Ge have same lattice structure. Why is C insulator while Si and Ge intrinsic semiconductors?

Watch Video Solution

2. Suppose a pure Si crystal has 5×10^{28} atoms m^{-3}. It is doped by 1 ppm concentration of pentavalent As. Calculate the number of electrons and holes. Given that $n_i = 1.5 \times 10^{16} m^{-3}$.

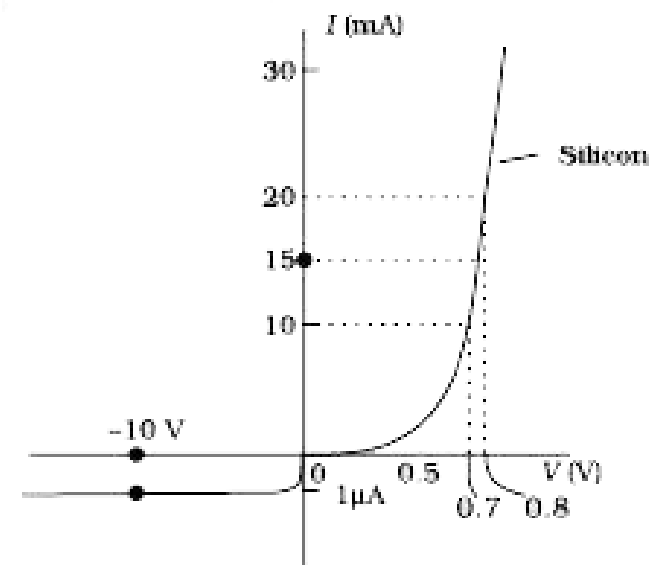
Watch Video Solution

3. Can we take one slab of p-type semiconductor and physically join it to another n-type semiconductor to get p-n junction?

Watch Video Solution

4. The V-I characteristic of a silicon diode is shown in the Fig. 14.17. Calculate the resistance of the diode at $(a) I_D = 15$ mA and (b)

$V_B = -10V$



Watch Video Solution

5. 5 In a Zener regulated power supply a Zener diode with $V_Z = 6.0V$ is used for regulation. The load current is to be 4.0 mA and the

unregulated input is 10.0 V. What should be the value of series resistor R_S?

Watch Video Solution

6. The current in the forward bias is known to be more (~mA) than the current in the reverse bias (~μA). What is the reason then to operate the photodiodes in reverse bias?

Watch Video Solution

7. Why are Si and GaAs are preferred materials for solar cells?

8. Justify the output waveform (Y) of the OR gate for the following inputs A and B given in

9. Take A and B input waveforms similar to that in Example. Sketch the output waveform obtained from AND gate.

Watch Video Solution

10. Sketch the output Y from a NAND gate having inputs A and B given below:

Watch Video Solution

Exercises

1. In an n-type silicon, which of the following statement is true:

A. Electrons are majority carriers and trivalent atoms are the dopants.

B. Electrons are minority carriers and pentavalent atoms are the dopants.

C. Holes are minority carriers and pentavalent atoms are the dopants.

D. Holes are majority carriers and trivalent atoms are the dopants

Answer: c

Watch Video Solution

2. Which of the statements given in Exercise is true for p-type semiconductos.

A. Electrons are majority carriers and trivalent atoms are the dopants.

B. Electrons are minority carriers and pentavalent atoms are the dopants.

C. Holes are minority carriers and pentavalent atoms are the dopants.

D. Holes are majority carriers and trivalent atoms are the dopants

Answer: d

 Watch Video Solution

3. Carbon, silicon and germanium have four valence electrons each. These are characterised by valence and conduction bands separated by energy band gap respectively equal to $(E_g)_C$, $(E_g)_{Si}$ and $(E_g)_{Ge}$. Which of the following statements is true?

A. $(E_g)_{Si} < (E_g)_{Ge} < (E_g)_C$

B. $(E_g)_C < (E_g)_{Ge} > (E_g)_{Si}$

C. $(E_g)_C > (E_g)_{Si} > (E_g)_{Ge}$

D. $(E_g)_C = (E_g)_{Si} = (E_g)_{Ge}$

Answer: c

Watch Video Solution

4. 4 In an unbiased p-n junction, holes diffuse from the p-region to n-region because

A. free electrons in the n-region attract them.

B. they move across the junction by the potential difference.

C. hole concentration in p-region is more as compared to n-region.

D. All the above.

Answer: c

 Watch Video Solution

5. When a forward bias is applied to a p-n junction, it

A. raises the potential barrier.

B. reduces the majority carrier current to zero.

C. lowers the potential barrier.

D. None of the above.

Answer: c

 Watch Video Solution

6. In half-wave rectification, what is the output frequency if the input frequency is 50 Hz. What is the output frequency of a full-wave rectifier for the same input frequency.

Watch Video Solution

7. A p-n photodiode is fabricated from a semiconductor with band gap of 2.8 eV. Can it detect a wavelength of 6000 nm?

Watch Video Solution

Additional Exercises

1. The number of silicon atoms per m^3 is 5×10^{28}. This is doped simultaneously with 5×10^{22} atoms per m^3 of Arsenic and 5×10^{20} per m^3 atoms of Indium. Calcualte the number of electrons and holes. Given that $n_i = 1.5 \times 10^{16} m^{-3}$. Is the material n-type or p-type?

Watch Video Solution

2. In an intrinsic semiconductor the energy gap Eg is 1.2eV. Its hole mobility is much smaller than electron mobility and independent of temperature. What is the ratio between conductivity at 600K and that at 300K? Assume that the temperature dependence of intrinsic carrier concentration n_i is given by:

$$n_i = n_o \exp\left(- \frac{E_g}{2k_B T} \right)$$

Where n_0 is a constant.

Watch Video Solution

3. In a p-n junction diode, the current I can be expressed as

$$I = I_0 \exp\left(\frac{eV}{2k_BT} - 1\right)$$

where I_0 is called the reverse saturation current, V is the voltage across the diode and is positive for forward bias and negative for reverse bias, and I is the current through the diode, k_B is the Boltzmann constant $\left(8.6 \times 10^{-5} eV/K\right)$ and T is the absolute temperature. If for a given diode $I_0 = 5 \times 10^{-12}$ A and T = 300 K, then

(a) What will be the forward current at a forward voltage of 0.6 V?

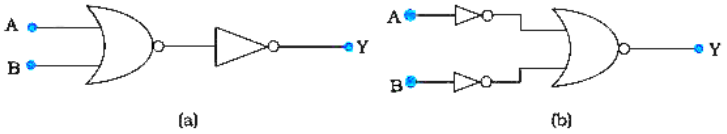
(b) What will be the increase in the current if the voltage across the diode is increased to 0.7 V?

(c) What is the dynamic resistance?

(d) What will be the current if reverse bias voltage changes from 1 V to 2 V?

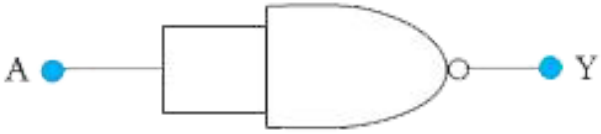
Watch Video Solution

4. You are given the two circuits as shown in Fig. 14.36. Show that circuit (a) acts as OR gate while the circuit (b) acts as AND gate.



Watch Video Solution

5. Write the truth table for a NAND gate connected as given in Fig. 14.37.

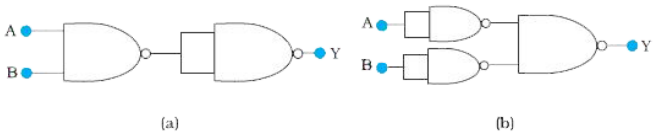


Hence identify the exact logic operation carried out by this circuit.

Watch Video Solution

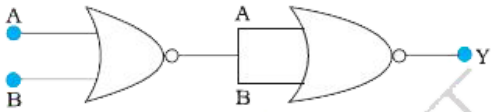
6. You are given two circuits as shown in Fig. 14.38, which consist of NAND gates. Identify the logic operation carried out by the two

circuits.



Watch Video Solution

7. Write the truth table for circuit given in Fig. 14.39 below consisting of NOR gates and identify the logic operation (OR, AND, NOT) which this circuit is performing.



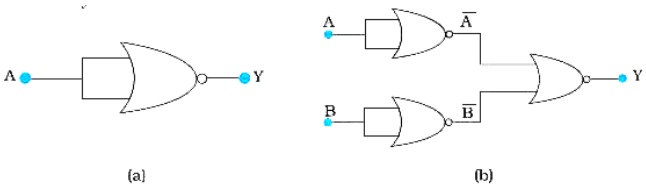
(Hint: A = 0, B = 1 then A and B inputs of

second NOR gate will be 0 and hence Y=1. Similarly work out the values of Y for other combinations of A and B. Compare with the truth table of OR, AND, NOT gates and find the correct one.)

Watch Video Solution

8. Write the truth table for the circuits given in Fig. 14.40 consisting of NOR gates only. Identify the logic operations (OR, AND, NOT)

performed by the two circuits.



Watch Video Solution